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Global burden of Alzheimer's disease and other dementias in adults aged 65 years and over, and health inequality related to SDI, 1990–2021: analysis of data from GBD 2021

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Abstract

Introduction The disease burden of dementia in the elderly is predicted to rise, and dementia among older adults has become a crucial issue for public health. Quantifying the disease burden of dementia in the elderly can provide relevant areas and countries with scientific data to help them adjust their healthcare strategies.

Methods We analyzed the disease burden of Alzheimer's disease and other dementias among individuals aged 65 and older from 1990 to 2021; the relationship between mortality rates and disability-adjusted life years (DALYs) with socio-demographic index (SDI); conducted a frontier analysis of the disease burden across 204 countries; and quantified inequalities in age-standardized DALYs for Alzheimer's disease and other dementias using the slope inequality index and concentration index.

Results Globally, age-standardized DALYs and mortality rates for individuals aged 65 and older have declined over time. We find that the disease burden of dementia is significantly associated with SDI. High SDI countries have 169% higher baseline levels of dementia burden compared to low SDI countries, as estimated based on their current level of social development. Finally, our health inequality analyses reveal that while the overall trend of DALYs for dementia increases with SDI, the burden is primarily concentrated in populations with lower SDI, as non-developed countries account for the majority of the population.

Conclusion The global population aged 65 and older experiences a significant reduction in healthy life expectancy due to dementia. The burden of disease in most countries is higher than the minimum disease burden associated with SDI in those countries. The burden of disease in low and middle SDI countries has been showing an increasing trend. The gap in disease burden among regions with different SDI levels is also continuously narrowing.

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Keywords Global burden of disease study, Aged 65 years and over, Dementia, Alzheimer's disease and other dementias, Inequality

Introduction

Dementia is a collective term for a group of neurodegenerative diseases that affect cognitive function, characterized by a significant decline in cognitive abilities, impacting memory, communication, and the ability to perform daily activities [1]. Dementia includes several types, such as Alzheimer's disease, Lewy body dementia, Parkinson's disease dementia, vascular dementia, Mixed dementia, and dementia caused by traumatic brain injury, with Alzheimer's disease and Lewy body dementia being the most common [2–4]. According to estimates, there are 14 modifiable risk factors that account for 45% of dementia cases [5]. These include vision impairment, elevated LDL cholesterol levels, low educational attainment, hearing impairment, smoking, obesity, and social isolation [5]. 90% of dementia patients also have behavioral and psychological symptoms such as agitation, aggressiveness, depression, and psychosis, in addition to cognitive impairment [6]. As the disease progresses, dementia patients may have trouble recognizing relatives and friends, speaking, and in the later stages, swallowing and urinating [7]. Mortality due to dementia is often caused by complications such as pulmonary diseases, epilepsy, hip fractures, and cardiovascular diseases [8]. Dementia has an enormous financial burden on society, the medical system, and patients' families [9]. Increased emotional burden on dementia patients' families, who are dealing with emotional stress, financial pressure, and the physical and mental strain of caregiving [10]. Family caregivers of dementia patients are significantly more likely to experience anxiety and depression [11].

A predictive study based on Global Burden of Disease (GBD) indicates that in 2019, 57.4 million individuals were thought to be suffering from dementia; the population is predicted to grow and age, with a significant increase reaching 152.8 million by 2050 [12]. It is anticipated that the rise rate of dementia cases will fluctuate throughout regions, with population aging and growth serving as the primary catalysts [12]. Dementia is more common in females than in males. In 2019, the ratio of female to male was 1.69, and it is expected to remain that way by 2050 [12]. The global burden of dementia is increasing, with a more pronounced trend in high SDI regions, particularly among the elderly population [13]. Among Americans 65 and older, Alzheimer's disease is currently the fifth most common cause of death, Alzheimer's disease-related fatalities rose by more than 140% between 2000 and 2021 [10]. According to the latest GBD 2021 research on the burden of neurological disorders, Alzheimer's disease and other dementias are among the top ten diseases in the world that cause the highest age-standardized DALYs [14]. In 2021, the age-standardized prevalence of dementia for females was 770 per 100,000, whereas for males it was 590 per 100,000, yielding a DALYs ratio of 1.37 for females compared to males [14].

The aim of this study is to use a comprehensive approach to evaluate the disease trends, health status, and health disparities of the population aged 65 and older with dementias, including Alzheimer's disease, across 21 regions, and 204 countries. This includes a secondary analysis of the disease burden indicators from the GBD 2021 study, as well as an analysis of the disability-adjusted life years (DALYs) for dementia based on the frontier analysis and health inequality analysis proposed by the WHO [15–18]. Visualize the burden of dementia in various national regions and provide targets for reducing its impact across different countries. Assess whether the burden of dementia is unequally distributed across countries with different levels of development.

Methods

Data source

The GBD database is a project led by the Institute for Health Metrics and Evaluation at the University of Washington, which analyzes and evaluates various disease burden indicators for multiple regions and a variety of diseases [19]. GBD collaborators process sparse, chaotic, and heterogeneous data using the Dismod-MR tools and a meta-analysis integrated estimation for disease burden research [20]. Based on GBD 2019, the data were modeled using a complicated and thorough modeling methodology that included Bayesian approaches, age-pattern models, and chamber models, resulting in a useful data structure pattern [21]. In this study, all the data used comes from GBD 2021. Related links: https://vizhub.healthdata.org/gbd-results/ and https://ghdx.healthdata.org/gbd-2021.

Data analysis

We collected data on the mortality and DALYs of dementia globally, across 21 regions and 204 countries, using the GBD 2021 query tool, searching by sex and age 65 and older. The international classification code for Alzheimer's disease and other dementias in GBD 2021 is defined in the supplementary appendix (Appendix 1). The GBD 2021 methods appendix provides detailed information on the disease models for Alzheimer's disease and other dementias (Appendix 2). The trend of the dementia disease burden is measured using the age-standardized rate

(ASR) and estimated annual percentage change (EAPC). The beta value of EAPC is determined using a linear regression equation [22]. The calculation method can be found in Appendix 3. We analyzed trends in the disease burden of dementia among individuals aged 65 and older, globally, across 21 regions, and in 204 countries from 1990 to 2021. Subsequently, we assessed the potential for reducing age-standardized DALYs in these 204 countries under current economic and health conditions, and finally conducted an analysis of health inequality related to dementia in the population aged 65 and older.

To evaluate the correlation between the SDI index and age-standardized DALY rates for senior dementia patients, we used Frontier analysis to compute the survival potential frontier [23]. Compare the performing nations and areas with other nations and regions. This strategy recognizes leading countries and regions, then establishes criteria and goals for others. We calculated the "effective differences" for each country and area, which represent the difference between the current and potential burdens of dementia among the elderly, adjusted for the SDI [16, 24]. The specific formula can be found in Appendix 4.

We use the WHO's health inequality analysis to analyze and evaluate inequalities between various socioeconomic groups in terms of health status, disease load, access to healthcare services, and health outcomes [17]. Quantifying inequalities by using regression models to analyze the disease burden at various SDI levels across national boundaries. The midpoint of population ranks is used in this study to calculate the relative positions of DALYs and SDI, which are then examined using a weighted regression model [25]. We assessed the absolute and relative inequalities in the global burden of dementia using two key health inequality indicators: the Slope Index of Inequality (SII) and the Concentration Index (CI) [26]. The calculation method mentioned above can be found in Appendix 5.

All of the calculations, descriptive tables, graphs, and analytical approaches mentioned above were done with R software (v4.4.1). SII, CI, and EAPC were all presented with 95% confidence intervals (95% CIs).

Results

Global trends and trends by social-demographic index

Globally, the DALYs among those aged 65 and older linked to dementia grew by 176% between 1990 and 2021, from 11.77 million to 32.55 million (Tables 1 and 2). With an estimated annual average change rate of -0.03% (95% CIs: -0.05 to -0.01), the age-standardized DALYs for this age group increased by 1.03%, from 404 cases per 100,000 in 1990 to 408 cases per 100,000 in 2021(Tables 1 and 2). Between 1990 and 2021, the age-standardized DALYs for dementia among the population aged 65 and older increased in all five SDI regions, particularly in countries with low SDI (EAPC:0.24%; 95% CIs: 0.19 to 0.30) (Table 2 and Supplement Fig. 1).

Globally, dementia-related mortality among those aged 65 and older linked to dementia grew by 199% between 1990 and 2021, from 0.62 million to 1.88 million (Table 1 and Supplement Table 1). With an estimated annual average change rate of -0.02% (95% CI: -0.03 to -0.01), there was minimal increase in age-standardized mortality among individuals in this age group, remaining at 24 cases per 100,000 in both 1990 and 2021 (Table 1 and Supplement Table 1). Excluding the high SDI region, the age-standardized mortality rate for dementia among individuals aged 65 and older has shown an increase each year. This trend has been more noticeable in nations with low SDI (EAPC:0.45%; 95% CIs: 0.37 to 0.54) (Supplement Fig. 1). In terms of mortality and DALYs, the global burden of dementia has remained stable over the past 32 years, except for the low-middle SDI and low SDI regions (Supplement Fig. 2).

Global trend by sex and age subgroup

From 1990 to 2021, DALYs attributed to dementia have increased for both male and female. Specifically, the cases for male rose from 3.68 million in 1990 to 10.87 million in 2021, while for female, the cases increased from 8.10 million to 21.68 million during the same period (Table 2). For individuals aged 65 and older, the age-standardized DALYs attributed to dementia have increased since 1990. Specifically, the rate for male rose from 326 per 100,000 in 1990 to 335 per 100,000 in 2021 (Table 2). For female,

Table 1 Global and five SDI regions' percentage growth in the number of cases and age-standardized rates of dalys and mortality attributed to dementia, 1990–2021

location	DALYs		Mortality	
	Count_growth_percent (%)	ASR_growth_percent (%)	Count_growth_percent (%)	ASR_growth_percent (%)
Global	176	1.03	199	0.41
High SDI	132	-3.4	158	-3.23
High-middle SDI	172	4.64	193	1.99
Middle SDI	160	7.07	188	12.98
Low-middle SDI	200	7.54	231	12.88
Low SDI	262	5.47	289	3.91

DALYs: Disability-Adjusted Life Years; ASR: age-standardized rates

Table 2 Age standardized dalys and EAPC of Alzheimer's disease and other dementias in people aged ≥ 65 years at global and regional level, 1990–2021

	DALYs(95% UI)				
	Count(1990)	**ASR(1990)**	**Count(2021)**	**ASR(2021)**	**EAPC(95%CI)**
Global	11,776,011 (5403935to26214940)	404.19 (182.37to899.82)	32,558,570 (14907368to71154572)	408.35 (186.18to891.83)	-0.03% (-0.05to-0.01)
gender:					
Female	8,100,263 (3709144to17801172)	448.84 (203.12to985.7)	21,683,769 (9984654to46240728)	457.77 (211.06to976.16)	-0.01% (-0.02to0.01)
Male	3,675,748 (1671601to8473884)	326.17 (145.15to755.79)	10,874,801 (4943479to24890786)	334.55 (150.17to767.03)	0.04% (0.02to0.06)
age group:					
65–69 years	1,343,850 (601766to3030017)	365.67 (166.75to808.56)	3,127,092 (1409727to7085606)	381.31 (176.85to838.53)	0.09% (0.05to0.13)
70–74 years	1,640,092 (809183to3534102)	494.47 (248.54to1045)	4,126,749 (2067523to8978837)	511.72 (263.32to1081.17)	0.03% (-0.02to0.09)
75–79 years	2,216,229 (1087816to4964899)	648.11 (323.41to1426.98)	4,865,373 (2392862to10651565)	664.08 (335.16to1413.87)	-0.02% (-0.06to0.01)
80–84 years	2,917,360 (1318984to6600486)	1019.62 (468.48to2269.41)	7,290,270 (3360052to15997698)	1029.16 (485.99to2198.97)	-0.04% (-0.09to0.01)
85–89 years	2,203,353 (989720to4832424)	993.2 (452.95to2144.43)	6,681,789 (3013871to14385687)	995.44 (459.17to2091.42)	-0.05% (-0.11to0.01)
90–94 years	1,048,957 (437197to2336350)	680.34 (288to1491.03)	4,343,993 (1829090to9371597)	674.89 (290.18to1424.15)	-0.04% (-0.11to0.04)
95 + years	406,170 (159270to916661)	352.92 (141.04to781.57)	2,123,304 (834243to4683583)	344.63 (138.27to743.84)	-0.1% (-0.19to-0.02)
SDI level:					
High SDI	4,761,619 (2205044to10383719)	434.45 (199.34to946.74)	11,024,310 (5067623to23247245)	419.69 (194.82to885.33)	-0.12% (-0.13to-0.12)
High-middle SDI	3,072,960 (1403703to6889211)	417.89 (186.6to940.1)	8,358,726 (3863114to18263756)	437.28 (201.07to956.29)	0.06% (0.04to0.08)
Middle SDI	2,431,788 (1104099to5494664)	389.09 (173.01to882.63)	8,814,835 (4074477to19409086)	410.37 (187.79to903.03)	0.03% (0to0.06)
Low-middle SDI	1,101,045 (507581to2516308)	298.94 (135.64to684.39)	3,302,837 (1464524to7593268)	321.48 (140.72to737.43)	0.23% (0.22to0.24)
Low SDI	395,987 (177369to915042)	320.7 (139.88to747.56)	1,030,843 (444597to2443524)	343.37 (144.77to812.62)	0.24% (0.19to0.3)

DALYs: Disability-Adjusted Life Years; EAPC: Estimated annual percentage change; UI: uncertainty interval; CI: confidence interval; SDI: Socio-demographic index

it increased from 449 per 100,000 to 458 per 100,000 during the same period (Table 2). Notably, the overall disease burden is higher for females, however the increase is faster for males (EAPC for female: -0.01% vs. EAPC for male: 0.04%) (Table 2).

Globally, from 1990 to 2021, DALYs attributed to dementia in each age subgroup has been increasing. Compared to other age subgroups, the age-standardized DALYs is highest among the population aged 80–84. Notably, the burden of dementia among persons aged 65–69 has tended to increase year by year (EAPC: 0.09%; 95% CIs: 0.05 to 0.13), while conversely, the burden of dementia among persons aged over 95 has tended to decrease year by year (EAPC: -0.1%; 95% CIs: -0.19 to -0.02) (Table 2).

From 1990 to 2021, the number of deaths attributed to dementia increased, with male mortality rising from 0.18 million in 1990 to 0.59 million in 2021, and female mortality increasing from 0.44 million to 1.28 million. The annual increase rate for males is faster than that for females (EAPC: 0.07% vs. EAPC: -0.01%) (Supplement Table 1).

Globally, from 1990 to 2021, the number of deaths attributed to dementia among each age subgroup of the population aged 65 and older has increased. Compared to other age subgroups, the age-standardized mortality rate is highest among the population aged 85–89. The age-standardized mortality rate for dementia has increased annually for the population aged 65–69 and 70–74, while it has decreased annually for those aged 80 and over (Supplement Table 1 and Supplement Fig. 1).

Globally, the age-standardized DALYs and mortality rates have changed steadily for both male and female, except in low-middle SDI and low SDI regions. (Supplement Fig. 2).

Regional trend

From 1990 to 2021, among 21 regions worldwide, the age-standardized DALYs attributed to dementia in the Central Sub-Saharan Africa population aged 65 and older were the highest (538 per 100,000), while Andean Latin America had the lowest (240 per 100,000) (Supplement Table 1). Age-standardized DALY increases are fastest in South Asia (EAPC: 0.42%; 95% CIs: 0.39 to 0.45) and second fastest in Central Sub-Saharan Africa (EAPC: 0.37%; 95% CIs: 0.34 to 0.40), while Australasia has decreased (EAPC: -0.32%; 95% CIs: -0.34 to -0.31) (Supplement Fig. 3).

In 21 global regions, Central Sub-Saharan Africa had the highest age-standardized mortality rates (34 per 100,000) among the population aged 65 and older in 2021, while Andean Latin America had the lowest rate (13 per 100,000) (Supplement Table 3). South Asia (EAPC: 0.72%; 95% CIs: 0.67 to 0.76) has the fastest annual increase in age-standardized mortality rates, while North Africa and Middle East has decreased (EAPC: -0.3%; 95% CIs: -0.35 to -0.26) (Supplement Fig. 3).

Interestingly, however, with the exception of Southern Sub-Saharan Africa, where the EAPC in age-standardized DALYs (EAPC: 0.05%; 95% CIs: -0.01 to 0.10) was not statistically significant, the burden of disease from dementia in Sub-Saharan Africa increased over time.

After stratifying by gender, females in Central Sub-Saharan Africa bear the heaviest disease burden, while females in Andean Latin America bear the lightest disease burden. That being said, the burden of disease is highest among males in East Asia, lowest in male mortality in Andean Latin America (Supplement Table 4). The estimated annual average variations of mortality and age-standardized DALYs by gender were highest in South Asia (Supplement Fig. 4).

National trend

From 1990 to 2021, Peru had the lowest age-standardized DALYs for dementia among the population aged 65 and older (243 per 100,000 to 237 per 100,000), while the Democratic Republic of the Congo had the highest (481 pre 100,000 to 546 per 100,000) (Supplement Table 5). The United Arab Emirates had the largest estimated annual percentage decrease in age-standardized DALYs due to dementia (EAPC: -0.41%; 95% CIs: -0.51 to -0.32), whereas India had the largest estimated annual percentage change (EAPC: 0.55%; 95% CIs: 0.51 to 0.59) (Fig. 1).

From 1990 to 2021, Peru had the lowest age-standardized mortality rate attributed to dementia among the

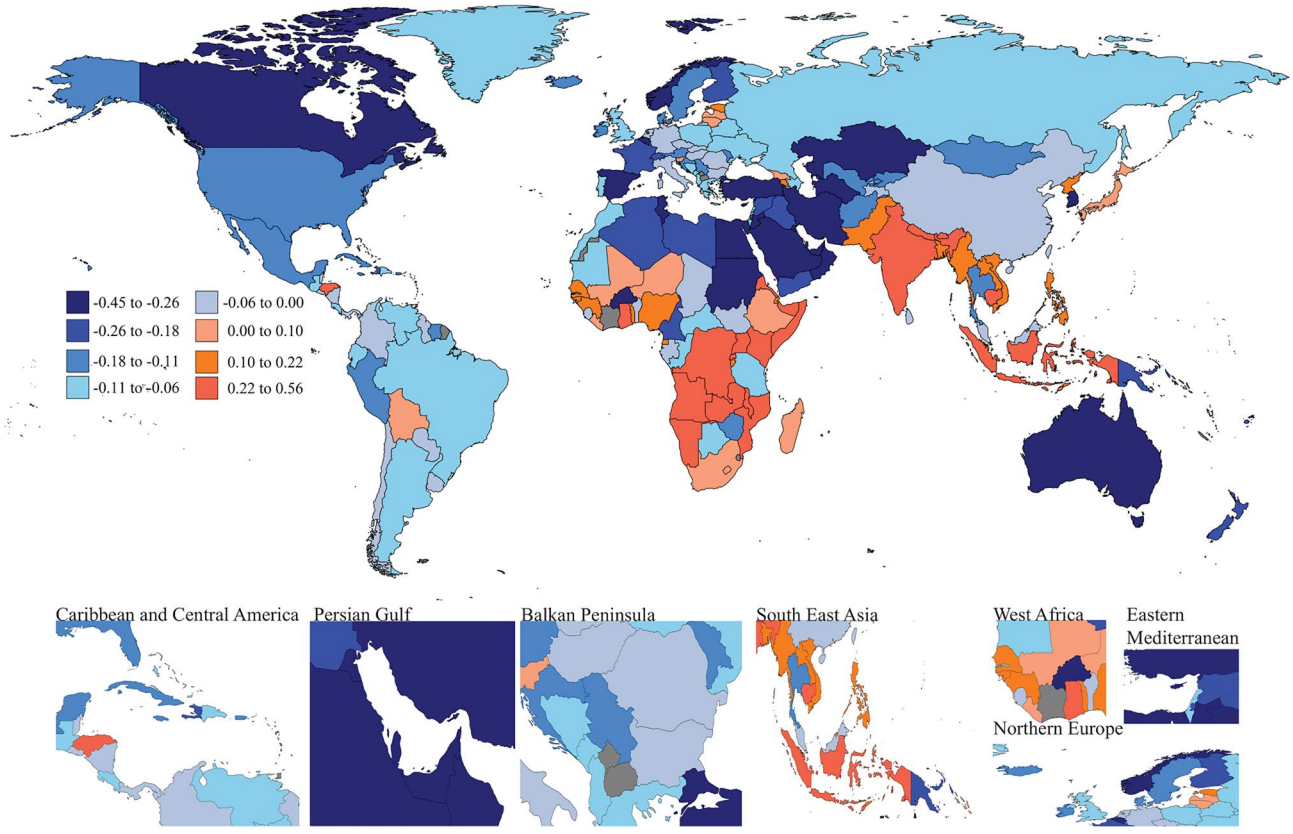

Fig. 1 Map showing Estimated Annual Percentage Change in global DALYs of Alzheimer's disease and other dementias among people aged ≥ 65 years, 1990–2021

population aged 65 and older in 2021 (14 per 100,000 to 13 per 100,000), while the Democratic Republic of the Congo had the highest rate (29 per 100,000 to 34 per 100,000) (Supplement Table 5). Guam had the largest estimated annual percentage decrease in age-standardized mortality rates due to dementia (EAPC: -0.72%; 95% CIs: -0.78 to -0.65), while India had the highest (EAPC: 0.91%; 95% CIs: 0.84 to 0.97) (Fig. 2).

Relationship with socio-demographic index

Between 1990 and 2021, the burden of dementia among the population aged 65 and older in 21 regions was significantly correlated with SDI ($p < 0.01$). Regions with a middle SDI, such as Southeast Asia, Andean Latin America and Tropical Latin America, exhibited a higher burden of disease (Supplement Fig. 5). Globally, the higher SDI, the heavier disease burden, and there is a significant correlation ($p < 0.01$). Notably, a higher burden of dementia is also observed in countries in non-high SDI regions (Supplement Fig. 6).

Frontier analysis

A comprehensive frontier analysis of the SDI and age-standardized DALYs attributable to dementia in 204 countries from 1990 to 2021 finds notable trends. As the SDI value increases from 0 to 1, the overall ASR for dementia exhibits an upward trend (Supplement Fig. 7A).

Italy, Japan, Germany, Belgium, and Greece are the 5 nations with the greatest effective differences from the minimum disease burden. The five high SDI nations with the greatest effective differences from the minimum disease burden are Japan, Germany, Belgium, Monaco, and San Marino. This means that these countries need to improve their healthcare systems and resource allocation to reduce unnecessary disease burden and enhance health efficiency. In contrast, the five low SDI nations with the least effective differences from the minimum disease burden are Somalia, Niger, Guinea-Bissau, Chad, and Togo (Supplement Fig. 7B and Supplement Table 6).

Health inequalities analysis

This research has found that there is a significant absolute inequality in the burden of dementia, with countries that have a higher SDI bearing a greater burden; however, there are still low SDI countries that experience a high burden of dementia. The SII (Slope Index of Inequality) shows that the gap in dementia DALYs incidence between the highest and lowest countries in terms of SDI increased from 145.49 (95% CIs: 118.14 to 172.83) in 1990 to 152.81 (95% CIs: 123.83 to 181.79) in 2021.

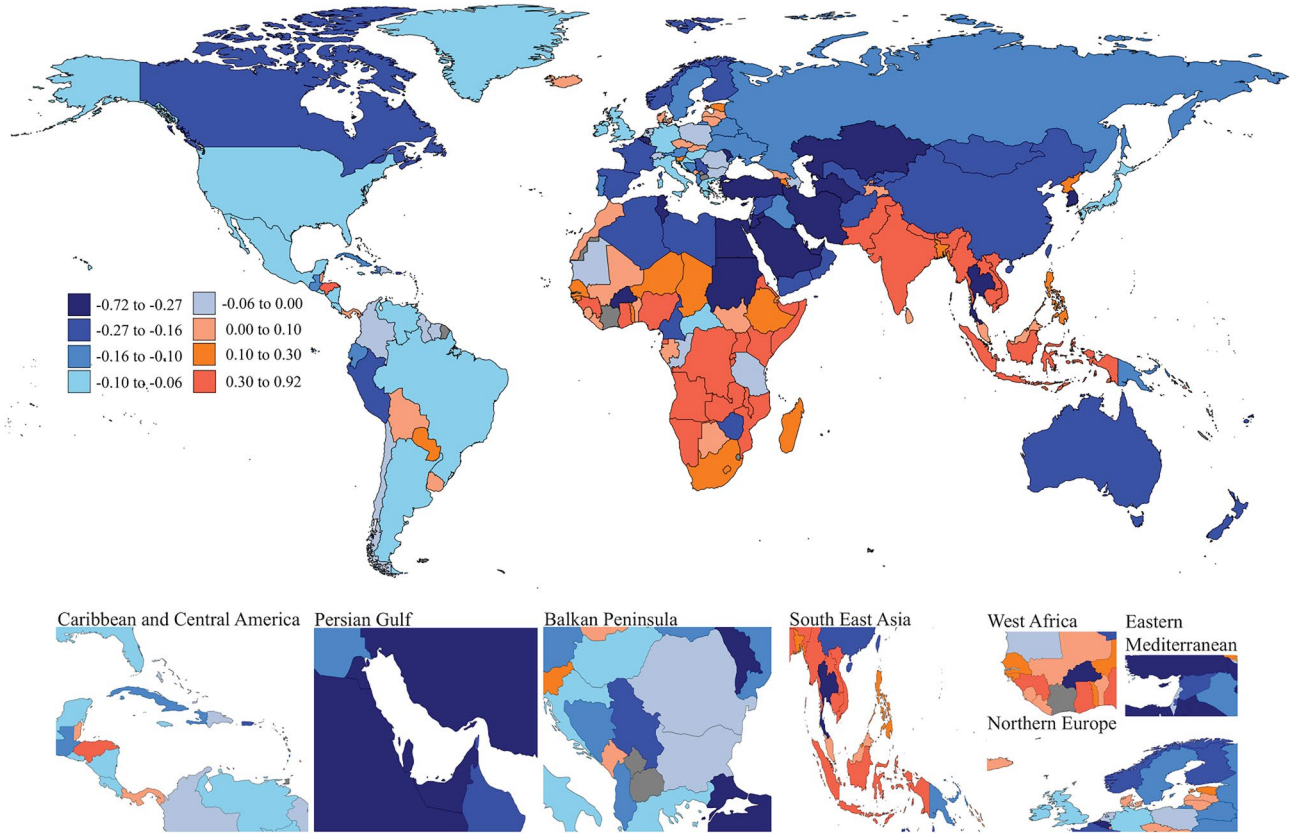

Fig. 2 Map showing Estimated Annual Percentage Change in global mortality of Alzheimer's disease and other dementias among people aged ≥ 65 years, 1990–2021

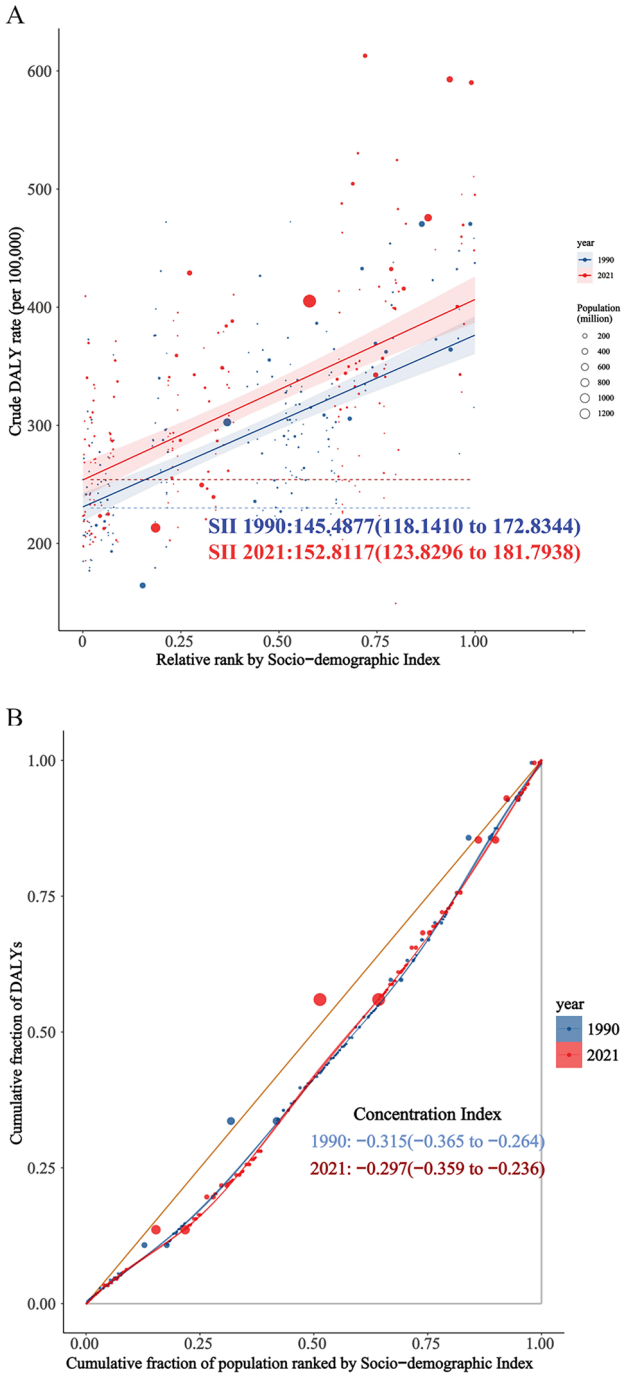

Fig. 3 Socio-Demographic Index inequality regression and concentration curves for the burden of DALYs due to Alzheimer's disease and other dementias in the world, 1990 and 2021

Meanwhile, the CI (Concentration Index) is significant, with values of -0.31 (95% CIs: -0.365 to -0.264) in 1990 and – 0.29 (95% CIs: -0.359 to -0.236) in 2021 (Fig. 3).

Discussion

This study utilized the latest GBD 2021 data to analyze the disease burden of dementia among the global population aged 65 and older, including DALYs and mortality rates. It examined the potential of different SDI levels to alleviate the burden of dementia, as well as the relationship between dementia burden and absolute SDI inequality.

According to our findings, the almost Sub-Saharan Africa region has the fastest-expanding dementia burden among those aged 65 and older, According to the WHO Population Prospects 2024 edition, although the population of Sub-Saharan Africa remains young, the number and proportion of the elderly population (aged 65 and over) will significantly increase by 2054 and will further rise by 2100 [27]. With an aging population, the region's healthcare and social security services will face an increased burden. The caregiver burden increases as the condition worsens due to a lack of information and understanding about dementia in Sub-Saharan Africa, as well as a lack of government aid, accessible resources, and expert supervision [28]. These factors will have an indirect effect on the disease burden of dementia. In regions with a high SDI (greater than 0.85), age-standardized DALYs and mortality are positively correlated, and countries with a higher SDI, such as Japan, and Germany, have a higher dementia burden, with Japan having the highest burden of disease. The reason could be that Japan, as a super-aged society, has the highest life expectancy in the world in 2019, with the proportion of the population aged 65 and up ranking first globally [29]. By 2050, it is predicted that one-third of Japan's population would be over the age of 65 [30]. The concentration of the high burden of dementia in high SDI countries may be explained by the fact that these countries tend to have, or are entering, aging societies and that they have a higher level of medical care, enabling them to diagnose dementia more accurately than other countries. At the same time, the treatment and care of elderly individuals with dementia often place a heavier financial burden on their families [29]. Due to the high cost of treatment and care, many families in low- to middle-SDI countries, such as India and other Southeast Asian countries, may choose not to seek treatment, delay seeking treatment, forgo treatment, or rely on informal caregivers, such as unpaid family members [31]. This may result in inadequate treatment for dementia patients in these countries, contributing to an increasing disease burden.

Our research confirms that the EAPC of age-standardized DALYs and mortality from dementia in individuals

aged 65 and older has decreased. Over the past decades, increased education levels, access to better medications, and healthier diets have reduced the incidence of dementia and mortality [32]. Medical advances have extended life expectancy for older adults, and this group is generally healthier [33]. Consequently, the relatively less healthy, dementia-prone individuals in the 85 and older population may have passed away earlier. Our research found that age-standardized DALYs and mortality for individuals aged 65 and older were higher in female than in male. As research progresses, there is an increasing recognition of the gender differences in the interactions of physiology, pharmacokinetics, and pharmacodynamics [34]. Females are more likely than males to have Alzheimer's disease and cerebrovascular disease pathology, whereas males are more likely to have Lewy body dementia [35]. A number of variables combine to produce the sex variations in the burden of dementia-related DALYs, for example the longer health expectancy of women, the effects of female steroid hormones on brain function, and the differences in brain structure between male and female [36]. Therefore, it is particularly important to continue in-depth research on sex differences in dementia, especially among patients aged 65 and older, to clarify the pathogenesis in different sexes, delay the impact of dementia on patients' daily lives, and thus improve the quality of life for those with dementia.

Through frontier analysis, it was found that from 1990 to 2021, the burden of disease for dementia in Somalia, Niger, and Guinea-Bissau with low SDI progressively approached the minimum disease burden for these regions. This might be linked to factors such as persistent violence, major population relocation, shortcomings in healthcare systems that hinder data collection, and local cultural perceptions that regard dementia as a normal part of the life process [37]. Countries such as Germany and Japan are experiencing a greater burden of dementia despite their current high SDI. These high-SDI nations possess significant potential to reduce the burden of dementia. Early screening, including genetic testing and cognitive function assessment, for individuals over 65 at risk of developing dementia is crucial for mitigating modifiable risk factors [38]. However, this may be difficult to achieve in regions with underdeveloped healthcare systems. Encouraging older residents to maintain healthy lifestyles, such as reducing alcohol consumption, encouraging social engagement, fostering physical activity, engaging in cognitive exercises and increasing educational opportunities in later life, can provide protective effects against Alzheimer's disease [38, 39].

Through the analysis of health inequalities, the SII reflects absolute inequality, measuring the linear trend of health outcomes in relation to socio-demographic development. Our findings indicate that among individuals aged 65 and older, DALYs increase with rising SDI, suggesting a heavier health burden in more economically developed regions. This is likely linked to longer life expectancy and more pronounced population aging in these areas [40, 41]. In contrast, the CI (Concentration Index) reflects relative inequality based on the concentration of the entire SDI spectrum. Our analysis reveals that, while the absolute health burden is greater among high SDI groups, the relative distribution of health burden is more concentrated among socio-demographically disadvantaged populations. In other words, the dementia burden among older adults in low SDI regions may be more pronounced, potentially contributing to the rapid increase in dementia cases in Sub-Saharan Africa. According to data from the United Nations and World Bank, the global population aged 65 and older is approximately 750 million in 2023 [28]. Notably, about 67-70% of this population resides in developing countries, equating to roughly 500 to 525 million older adults [42]. Based on the results of our study, in addition to fostering economic development, priority should be given to reducing dementia risk in the elderly. Suggested measures include universal education to promote healthy BMI management, and community-based cognitive exercises Simultaneously, the risks of dementia burden in underdeveloped areas should not be overlooked. Policy interventions must not only focus on groups with a high absolute dementia burden but also pay particular attention to those with a relatively concentrated burden in low SDI regions.

Study strengths and limitations

The strengths of this study are as follows: first, we analyzed the burden of disease in the primary population affected by dementia (individuals aged 65 years and older). Second, we applied frontier analyses to identify which of the 204 countries globally could most efficiently achieve baseline levels of DALYs for dementia by optimizing healthcare within the current level of social development. Finally, we examined whether the distribution of DALYs for dementia is associated with socioeconomic development using health inequality analyses.

The limitations of this study are as follows: first, all our data were derived from GBD 2021, making it difficult to avoid data loss and bias. Second, we analyzed only individuals aged 65 years and older, excluding the full age range. Finally, our analysis showed that the distribution model of DALYs in dementia is inherently complex, and only the SDI was included as an indicator for analyzing differences, without incorporating additional indicators to refine the model.

Conclusion

This study quantified and visualized the burden of dementia in people aged 65 years and older, finding an increasing trend in most countries over time. Using data from GBD 2021, we found a positive association between the burden of dementia in adults aged 65 years and older and the SDI. Frontier analyses revealed that the burden of dementia tended to approach the minimum disease burden in regions with low SDI. Even so, the burden of disease in areas with non-high SDI is not negligible. Health inequality analyses demonstrated a complex pattern in the distribution of dementia burden among adults aged 65 years and older, with significant burdens observed in both low and high SDI groups.

Abbreviations

DALYs	Disability-adjusted life years
SDI	Socio-demographic index
GBD	Global Burden of Disease
ASR	Age-standardized rate
EAPC	Estimated annual percentage change
SII	Slope Index of Inequality
CI	Concentration Index
95% CIs	95% confidence intervals

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12889-025-22378-z.

Supplementary Material 1

Supplementary Material 2

Supplementary Material 3

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Author contributions

Wen Liu and Wei Deng contributed equally to this work. Shuchun Yu and Shoulin Chen are co-corresponding authors.Shuchun Yu and Shoulin Chen designed the study. Wen Liu designed the analytic process. Wen Liu, Wei Deng, Xinhao Gong, and Jinping Ou retrieved the GBD data. Wen Liu, Wei Deng, Xinhao Gong, and Jinping Ou collaborated to conduct the statistical analysis and interpret the results. Wen Liu and Xinhao Gong wrote the manuscript, which was subsequently critically revised by the remaining writers. Shuchun Yu and Shoulin Chen suggested revisions to the first draft. Other authors revised the manuscript based on the revisions. Wei Deng and Jinping Ou collected and confirmed the basic data. All authors have read and approved the final version of the manuscript.

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Data availability

All the data used in the analysis of this study were obtained from https://vizhub.healthdata.org/gbd-results/.

Declarations

Ethics approval and consent to participate

The GBD 2021 project is an open database in which all data is anonymized. The University of Washington's Institutional Review Board reviewed and approved an informed consent waiver. (https://www.healthdata.org/research-analysis/gbd).

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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